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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Metallurgical vessel

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METALLURGICAL VESSEL

The invention relates to a metallurgical vessel comprising a lower portion for accommodating a molten metal bath and part of a slag layer in use, an upper portion for accommodating the remainder of the slag layer in use and a plurality of lances which project into the upper portion of the vessel and supply oxygen containing gas to the upper portion of the vessel. The present invention also relates to a method of iron making.

The term metallurgical vessel refers to a vessel suitable for treating metal or metal oxide, metal smelting, refining or reducing.

EP 0 735 146 describes a metallurgical vessel of the converter type, in which pre-reduced iron compounds are further reduced. Oxygen is supplied by means of a plurality of lances that project through the wall of the vessel and extend to above the slag layer. It is known from this document to introduce a gas through the bottom of the vessel into the molten metal in order to rinse the iron melt. This procedure is also known as bottom stirring or bottom bubbling in the art and is performed to agitate the molten metal in the lower portion of the vessel. Bottom stirring ensures sufficient heat transfer to the molten metal bath beneath the slag layer and sufficient stirring of the lower slag layer itself so that it does not become quiescent and so that heat generated in the upper slag layer is also transferred to the lower slag layer. Bottom stirring has considerable drawbacks such as, for example, increasing refractory erosion along the walls of the vessel in the area of the hot metal as well as requiring injection points beneath the tap level of the vessel that have a relatively short lifetime and are difficult to maintain.

The object of the present invention is to provide a metallurgical vessel having reduced refractory erosion and greater ease of maintenance without a reduction in production efficiency.

The present invention overcomes the problems of the prior art as the metallurgical vessel comprises a plurality of tuyeres arranged around the circumference of the lower portion of the vessel suitable for supplying gas and/or liquid and/or solids and/or plasma into the slag layer in the lower portion of the vessel.

The plurality of lances supply oxygen containing gas, and thereby heat, to the slag in the upper portion of the vessel whilst the gas and/or liquid and/or solids and/or plasma supplied by the tuyeres ensure that the lower slag layer does not become quiescent. Quiescence results in a cooling of the lower slag layer and a loss of productivity. The tuyeres supply gas and/or liquid and/or solids and/or plasma directly to the lower slag layer whereas gas is injected through the bottom of the vessel into the molten metal in bottom stirring. The present invention thus does not generate high flow velocities in the molten metal thereby avoiding one of the major drawbacks of bottom stirring namely the fast erosion of the vessel wall in the part of the vessel containing the molten metal. The supply of gas and/or liquid and/or solids and/or plasma to the slag layer in the lower portion of the vessel by the tuyeres thus does not cause erosion of the refractory lining in the hot metal zone but it does maintain productivity by stirring the lower slag layer. Stirring the lower slag layer maximises reactions within the lower slag layer and ensures it does not become quiescent. The supply of combustible gas and/or liquid and/or solids by the

tuyeres also increases heat transfer from the slag layer to the molten metal in the lower portion of the vessel. The tuyeres are also easier to maintain as they are positioned above the tap level of the vessel.

The diameter of the lower portion of the vessel may preferably be smaller than the diameter of the upper portion of the vessel. The tuyeres are arranged around the circumference of the lower part of the vessel and therefore the jets emitted by the tuyeres will penetrate into the slag layer in the lower portion of the vessel before rising through the slag into the upper portion of the vessel. Any "hot spots" i.e. areas of higher temperature, created by the gas and/or liquid and/or solids and/or plasma supplied by the tuyeres, in the slag layer in the upper portion of the vessel will therefore be sufficiently distant from the wall of the vessel to ensure that no increase in corrosion and/or erosion of the wall occurs.

The tuyeres may preferably comprise oxy-fuel burners to act as a direct heat source in the slag layer in the lower portion of the vessel. The oxy-fuel burners will increase the productivity of the reactor by increasing the occurrence of the endothermic reduction reactions and thereby increasing the reduction capacity of the slag layer.

The tuyeres preferably supply oxygen containing gas to the slag layer in the lower portion of the vessel. The oxygen contained in the gas will combust char into carbon monoxide thereby providing an additional source of heat in the slag layer and increasing the productivity of the reactor as explained for oxy-fuel burners.

At least ten tuyeres may be positioned around the lower portion of the vessel to ensure optimum distribution of the gas and/or liquid and/or solids and/or plasma, supplied by the tuyeres, into the slag layer.

The metallurgical vessel of the present invention preferably comprises a melting cyclone positioned above, and in open communication with, the vessel. Such a melting cyclone is described in Dutch patent NL C 257692 and EP 0690136.

The metallurgical vessel of the present invention may be used for iron making and steel making.

The present invention also relates to a method of reducing iron oxide to iron using a metallurgical vessel in accordance with the invention, comprising the steps of supplying iron oxide to the vessel, supplying oxygen containing gas to the interior of the metallurgical vessel, supplying carbonaceous material to the iron oxide and supplying gas and/or liquid and/or solids and/or plasma into the slag layer in the lower portion of the vessel via the plurality of tuyeres.

The present invention also relates to a method of iron making comprising the steps of:

- conveying iron-oxide containing material into the melting cyclone,
- pre-reducing said iron-oxide containing material by means of a partially post-combusted reducing process gas originating from the metallurgical vessel,
- at least partly melting the iron-oxide containing material in the melting cyclone by supplying oxygen containing gas to the melting cyclone and effecting a post-combustion in said reducing process gas,

- permitting the pre-reduced and at least partly melted iron-oxide containing material to pass downwardly from said melting cyclone into the metallurgical vessel in which final reduction takes place and
- effecting the final reduction in the metallurgical vessel in a slag layer, by supplying oxygen containing gas to the interior of the metallurgical vessel via a plurality of lances, by supplying coal to the interior of the metallurgical vessel and by supplying gas and/or liquid and/or solids and/or plasma to the lower slag layer via a plurality of tuyeres, and thereby forming said reducing process gas and effecting a partial post-combustion in said reducing process gas in said metallurgical vessel by means of said oxygen containing gas supplied thereto.

BRIEF INTRODUCTION TO THE DRAWINGS

Figure 1 shows an apparatus in accordance with the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

The apparatus in figure 1 comprises a metallurgical vessel 1 and a melting cyclone 8. Details of the melting cyclone are not shown. The metallurgical vessel itself comprises a lower portion 2 which accommodates the iron bath 9 and part of the slag layer 6 and comprises at least one tap hole 11 for tapping off molten iron and slag. The vessel also comprises an upper portion 3, which accommodates the remainder of the slag layer 6, and a roof portion 4. The slag layer 6 thus rests on top of the iron bath 9 and extends from the lower portion of the vessel 2 into the upper portion 3. Pre-reduced iron oxide 10 falls or flows from the melting cyclone into the metallurgical vessel and is finally reduced in the slag layer. A plurality of lances 5 supply oxygen containing gas to the slag layer 6 in the upper portion 3 of the vessel. Two lances are shown in the figure but more may be present depending on, for example, the size of the vessel and the performance parameters of the lances. A plurality of tuyeres 7 are arranged around the circumference of the lower portion of the vessel. The tuyeres are suitable for supplying gas and/or liquid and/or solids (such as recycled dust) and/or plasma to the slag layer in the lower portion 2 of the vessel. The number of tuyeres arranged around the circumference of the lower part of the vessel can be varied depending on the size of the vessel and the performance parameters of the tuyeres. The tuyeres may comprise oxy-fuel burners. During the final reduction of the pre-reduced iron oxide a process gas comprising reducing CO is produced that is partially post-combusted above the slag layer 6 in the vessel 1, whereby heat needed for the final reduction is released. The reducing process gas rises and is further post-combusted in the melting cyclone 8 with oxygen containing gas supplied to the melting cyclone. Iron oxide supplied to the melting cyclone is pre-reduced approximately to FeO and at least partly melted in the melting cyclone. The pre-reduced iron oxide 10 then falls or flows down into the metallurgical vessel 1.

While the invention has been illustrated by a particular embodiment, variations and modifications are possible within the scope of the inventive concept.

CLAIMS

1. Metallurgical vessel comprising a lower portion for accommodating a molten metal bath and part of a slag layer in use, an upper portion for accommodating the remainder of the slag layer in use and a plurality of lances which project into the upper portion of the vessel and supply oxygen containing gas to the upper portion of the vessel characterised in that a plurality of tuyeres are arranged around the circumference of the lower portion of the vessel suitable for supplying gas and/or liquid and/or solids and/or plasma into the slag layer in the lower portion of the vessel.

2. Metallurgical vessel according to claim 1 characterised in that the diameter of the lower portion of the vessel is smaller than that of the upper portion.

3. Metallurgical vessel according to claims 1 or 2 characterised in that the tuyeres comprise oxy-fuel burners.

4. Metallurgical vessel according to any of the previous claims comprising a melting cyclone positioned above and in open communication with the metallurgical vessel.

5. Method of reducing iron oxide to iron using a metallurgical vessel in accordance with any one of claims 1-4, comprising the steps of supplying iron oxide to the vessel, supplying oxygen containing gas to the upper portion of the metallurgical vessel via the plurality of lances, supplying carbonaceous material to the iron oxide and supplying gas and/or liquid and/or solids and/or plasma into the slag layer in the lower portion of the vessel via the plurality of tuyeres.

6. Method of reducing iron oxide according to claim 5 characterised in that the tuyeres supply oxygen containing gas into the lower slag layer.

7. Method of iron making comprising the steps of:
   - conveying iron-oxide containing material into the melting cyclone,
   - pre-reducing said iron-oxide containing material by means of a partially post-combusted reducing process gas originating from the metallurgical vessel,
   - at least partly melting the iron-oxide containing material in the melting cyclone by supplying oxygen containing gas to the melting cyclone and effecting a post-combustion in said reducing process gas,
   - permitting the pre-reduced and at least partly melted iron-oxide containing material to pass downwardly from said melting cyclone into the metallurgical vessel in which final reduction takes place and

effecting the final reduction in the metallurgical vessel in a slag layer, by supplying oxygen containing gas to the interior of the metallurgical vessel via a plurality of lances, by supplying coal to the interior of the metallurgical vessel and by supplying gas and/or liquid and/or solids and/or plasma to the lower slag layer via a plurality of tuyeres, and thereby forming said reducing process gas and effecting a partial post-combustion in said reducing process gas in said metallurgical vessel by means of said oxygen containing gas supplied thereto.

ABSTRACT

Metallurgical vessel comprising a lower portion for accommodating a molten metal bath and part of a slag layer in use, an upper portion for accommodating the remainder of the slag layer in use and a plurality of lances which project into the upper portion of the vessel and supply oxygen containing gas to the upper portion of the vessel characterised in that a plurality of tuyeres are arranged around the circumference of the lower portion of the vessel suitable for supplying gas and/or liquid and/or solids and/or plasma into the slag layer in the lower portion of the vessel.

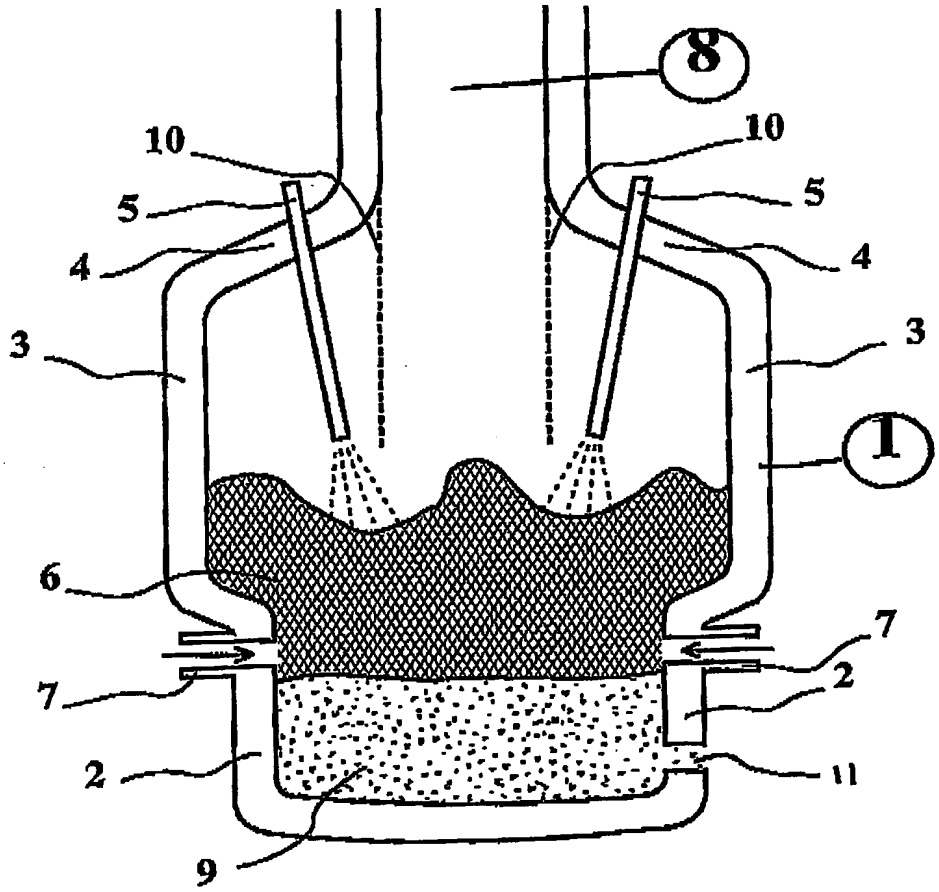

Fig. 1